

Listing of Claims:

Claim 1 (previously presented): In a packet switched computer network, a method of estimating periodic worst-case delay for a traffic aggregate having an associated rate, the method comprising:

collecting traffic data comprising arrival time and size of packets arriving at a queue of a router, said queue associated with the traffic aggregate over a time interval;

calculating a burst parameter based on the traffic data collected at said queue;

calculating a burst-rate traffic profile responsive to the traffic data collected over said time interval and the associated rate, wherein the associated rate is a predetermined rate; and

calculating a periodic worst-case delay for the burst-rate traffic profile.

Claim 2 (original): A method as in claim 1 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

Claim 3 (canceled).

Claim 4 (previously presented): A method as in claim 1 wherein the associated rate is a negotiated rate agreed to by a customer sending the traffic data.

Claim 5 (canceled).

Claim 6 (previously presented): A method as in claim 1 wherein the periodic worst-case delay is calculated by dividing the burst parameter by an allocated bandwidth associated with the queue.

Claim 7 (original): A method as in claim 1 wherein the queue is allotted a share of an output link capacity, said share exceeding the associated rate.

Claim 8 (original): A method as in claim 1 wherein the traffic aggregate is a class of traffic.

Claim 9 (previously presented): In a packet switched network, a method of estimating worst-case queuing delay along a path, said path comprising routers, the method comprising:

periodically collecting a rate parameter and a burst parameter associated with a queue for each of a plurality of routers;

calculating a periodic worst-case delay associated with the rate and burst parameters for said each of a plurality of routers; and

adding up the delay associated with the routers along the path.

Claim 10 (canceled).

Claim 11 (previously presented): In a packet switched network, a method of estimating periodic worst-case queuing delay for a class of traffic at a router, the class of traffic having a negotiated rate, the method comprising:

receiving packets at an input interface of a router;

sending each packet to one of a plurality of streams responsive to a customer identification;

sending each packet in at least one of the plurality of streams to one of a plurality of queues responsive to a class field, each of said plurality of queues having an associated rate;

monitoring an arrival time and size of said each packet at the one of the plurality of queues during an interval of time;

calculating a burst parameter;

calculating a burst-rate traffic profile responsive to the arrival time and size of said each packet and the negotiated rate; and

calculating a periodic worst-case delay for the burst-rate traffic profile.

Claim 12 (canceled).

Claim 13 (canceled)

Claim 14 (previously presented): In a packet switched network, an apparatus for estimating worst-case delay for a traffic aggregate having an associated rate, the apparatus comprising:

a monitor that collects traffic data comprising arrival time and size of packets arriving at a queue of a router, said queue associated with the traffic aggregate over a time interval;

a processor; and

a computer readable medium coupled to the processor and storing a computer program comprising:

code that causes the processor to receive the traffic data;

code that causes the processor to calculate a burst parameter based on the traffic data collected at said queue;

code that causes the processor to calculate a burst-rate traffic profile responsive to the collected traffic data and the associated rate; and

code that causes the processor to calculate a periodic worst-case delay for the traffic profile.

Claim 15 (previously presented): An apparatus as in claim 14 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

Claim 16 (canceled).

Claim 17 (canceled).

Claim 18 (previously presented): An apparatus as in claim 14 wherein the periodic worst-case delay is calculated by dividing the burst parameter by a allocated bandwidth of the queue.

Claim 19 (previously presented): An apparatus as in claim 14, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, hard drive, or data signal embodied in a carrier wave.

Claim 20 (previously presented): In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

a monitor agent that periodically collects traffic parameters associated with a queue for each of a plurality of routers;

a processor that can receive information from the monitor agent; and

a computer readable medium coupled to the processor and storing a computer program comprising:

code that causes the processor to receive burst and rate traffic parameters collected by the monitor agent;

code that causes the processor to calculate a delay associated with the traffic parameters for said each of a plurality of routers; and

code that causes the processor to add up the delay associated with the routers along the path.

Claim 21 (canceled).

Claim 22 (previously presented): The apparatus of claim 20, wherein the computer readable medium is a CD-ROM, floppy disk, flash memory, system memory, hard drive, or data signal embodied in a carrier wave.

Claim 23 (previously presented): In a packet switched network, an apparatus for estimating periodic worst-case delay for a traffic aggregate having an associated rate, the apparatus comprising:

means for collecting traffic data comprising arrival time and size of packets arriving at a queue of a router, said queue associated with the traffic aggregate over a time interval;

means for calculating a burst parameter based on the traffic data collected at said queue;

means for calculating a burst-rate traffic profile responsive to the collected traffic data and the associated rate; and

means for calculating a periodic worst-case delay for the traffic profile.

Claim 24 (previously presented): An apparatus as in claim 23 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

Claim 25 (previously presented): In a packet switched network, an apparatus for estimating periodic worst-case queuing delay along a path, said path comprising routers, the apparatus comprising:

means for periodically collecting rate and burst traffic parameters associated with a queue for each of a plurality of routers;

means for calculating a delay associated with the traffic parameters for said each of a plurality of routers; and

means for adding up the delay associated with the routers along the path.

Claim 26 (canceled).

Claim 27 (previously presented): A computer program product for estimating periodic worst-case delay at a queue in a packet switched network, the computer program product comprising:

computer code that causes a processor to collect traffic data comprising arrival time and size of packets arriving at the queue of a router over a time interval, said traffic data having an associated negotiated rate;

computer code that causes a processor to calculate a burst traffic parameter for the collected traffic;

computer code that causes a processor to calculate a burst-rate traffic profile responsive to the collected traffic data and the associated negotiated rate;

computer code that causes a processor to calculate a periodic worst-case delay for the traffic profile and a allocated bandwidth associated with the queue; and

a computer readable medium storing said computer code.

Claim 28 (previously presented): A computer program product as in claim 27 wherein the traffic data includes packet size and arrival time of each packet arriving at the queue during the time interval.

Claim 29 (previously presented): A computer program product for estimating worst-case queuing delay along a path in a packet switched network, said path comprising routers, the computer program product comprising:

computer code that causes a processor to collect burst and rate traffic parameters associated with a queue for each of a plurality of routers;

computer code that causes the processor to calculate a delay associated with the traffic parameters for said each of a plurality of routers; and

computer code that causes the processor to add up the delay associated with the routers along the path; and

a computer readable storage medium storing said code.

Claim 30 (canceled).

Claim 31 (previously presented): In a packet switched network, a method of estimating worst-case queuing delay along a path, said path comprising routers, the method comprising:

calculating periodic worst-case delay associated with a queue for each of a plurality of routers;

periodically collecting periodic worst-case delay from said each of a plurality of routers; and

adding up the delay associated with the routers along the path,

wherein said periodic worst-case delay is based on a burst parameter and a rate parameter.

Claim 32 (canceled).

Claim 33 (previously presented): The method of claim 1 wherein calculating the burst-rate traffic profile comprises utilizing a token bucket.

Claim 34 (previously presented): The method of claim 33 wherein the token bucket size corresponds to a maximum burst rate.

Claim 35 (previously presented): The method of claim 1 wherein a replenishment rate of the token bucket is based on the associated rate.

Claim 36 (previously presented): The method of claim 1 wherein the burst parameter is calculated utilizing token buckets and the associated rate is set to a negotiated rate for a specified class of traffic.

Claim 37 (previously presented): The method of claim 1 wherein the associated rate is a maximum average bandwidth specified in a service level agreement.

Claim 38 (previously presented): The method of claim 1 wherein the burst-rate traffic profile comprises a y-intercept corresponding to the calculated burst parameter and a slope corresponding to the associated rate.

Claim 39 (previously presented): The method of claim 1 further comprising calculating a cumulative bandwidth profile having a slope equal to allocated bandwidth.

Claim 40 (previously presented): The method of claim 1 further comprising calculating error of data by comparing collected data to the burst-rate traffic profile.

Claim 41 (previously presented): The method of claim 39 further comprising calculating a new burst parameter if the error of data is higher than a predetermined limit.